

## TIN

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**T**he price of tin is expected to continue its dramatic rise from the 2003 London Metal Exchange (LME) cash average of US\$4,894/t to perhaps US\$8,673/t in 2004, and to continue rising in 2005, according to Barclays Capital Research (in June 2004). Tin has risen from a 30-year low in February 2002 to a near 15-year high in the first quarter of 2004.

Behind tin's continuing rally and out-performance of other base metals is a genuine tightness in supply, buoyant demand and low inventories. From a record high of 39,475 t in August 2002, LME tin stocks fell to 6,820 t by the end of the first quarter of 2004, their lowest level since August 1998 and equivalent to less than two weeks' global consumption. The LME traded 1.5 million tin contracts in 2003.

Chinese demand (as with all commodities) has proved to be a major part of the tin price story but there are other factors at play as well. For example, the European Union is to ban the use of lead in various electronic devices starting in 2006, a prospect that is already forcing manufacturers to switch to alloys and solders with higher tin content.

Years of under-investment in production capacity and the high profile closure of the Renison Bell mine in Tasmania all contributed to short supply in 2003.

All analysts agree that there was a substantial supply deficit in 2003 but differ about just how big it was. The consensus estimate appears to be between 15,000 t and 20,000 t but the World Bureau of Metal Statistics' estimate is of a shortfall of 34,000 t! What is clear is that demand has been strong, will continue to be strong in 2004 and mine output is struggling to keep pace. By some estimates, global tin consumption exceeded 300,000 t for the first time in 2003, others say that barrier will be broken in 2004.

The five largest corporate producers, in order of importance, are PT Tambang Timah (Indonesia), Minsur SA (Peru), Malaysia Smelting Corp (Malaysia), Yunnan Tin Corp (China) and PT Koba Tin (Indonesia).

### **China**

Yunnan Tin Corp (YTC), China's largest tin producer, exported some 12,000 t in 2003, 38% of its total output. However, the government's cut in the export rebate at the start of 2004 is likely to mean lower exports for the year. Output, overall, is also likely to fall back from the 31,500 t recorded in 2003 as a result of lack of concentrate. YTC had originally forecast output for 2003 at 26,000 t but exceeded that target despite a near month-long shutdown in June. The smelter was also unaffected by the earthquake that hit Yunnan Province in November 2003.

The country's second largest tin producer, Liuzhou China Tin resumed mining at its Gaofeng tin mine, one of the five mines shut down by the Nandan local authorities in July 2001 after a flooding incident killed more than 80 miners. The five mines were reopened between June and August 2003 although operations were suspended again briefly in September. Over the past two years the company has struggled to find concentrate feed for its smelter. However, output for 2003 at around 13,000 t was up more than a third on the previous year and is expected to rise again to 15,000 t for 2004.

In July 2003, Guangzhou Smelter announced plans to restructure its operations and said it would not resume tin metal production at all in 2003, having shut down at the beginning of the year. Guangzhou Smelter had a 4,000 t/y production capacity, but in 2002 it produced only about 1,000 t and output in 2001 was just 600 t.

### **Indonesia**

PT Tambang Timah resumed offshore exploration for tin round the island of Kundur in the second quarter of 2003 as the company's finances continued to recover from the crisis it faced in 2001. In August 2003, the firm suggested it was considering listing on the Euronext cross-border exchange based in Amsterdam. By the end of the first quarter of 2004 the firm was being considered a privatisation target, with the government thinking about reducing its remaining stake from 65% to 41%. Through 2003 Timah continued to purchase concentrates from illegal mining operations as part of government policy to prevent unrest on the islands of Bangka and Belitung.

Indonesia has extensive onshore and offshore deposits mainly on and around the islands of Bangka, Belitung and Singkep off the east coast of Sumatra. The industry is dominated by PT Tambang Timah, which accounts for around 80% of the country's tin production. In 2003 the company produced 45,906 t of primary tin, achieving an average price for the year of US\$4817/t, up 15% on the previous year. Output for 2004 is expected to drop to around 42,000 t as a result of poorer ore grades.

Koba Tin, 75%-owned by Malaysia Smelting Corp (Timah owns the remaining 25%) is the only other major producer.

At the end of the year, Timah, arguably the world's largest integrated tin producer, confirmed plans to construct a second smelter. With a production capacity of up to 7,000 t/y, the new unit is planned for Kundur Island.

In June 2003, PT Tambang Timah and PT Koba Tin both joined the Kuala Lumpur Tin Market. Together, the two companies represent around 30% of global tin supply. The KTLM was originally established in June 1984 and trading began on October 1, 1986. It replaced the 75-year old Penang tin market. On September 17, 2001, it moved to electronic trading from an open outcry price fix.

In December 2003, Malaysia Smelting Corp announced plans to form a wholly-owned Indonesian subsidiary to enter into a joint venture with PT Mitra Stania Prima to explore and mine new areas on Bangka Island.

In March 2003, CV Donna Kembara Jaya established a smelting operation with the capacity to produce 6,000 t/y in the Bangka Regency.

### **Peru**

Minsur, the world's second-largest corporate tin producer is working to expanded both mined and refined output. The firm has exported no concentrate since 2002, preferring to smelt its tin concentrates at the wholly-owned Funsur smelting facility. In September, Minsur confirmed plans to invest US\$8 million in exploration around its San Rafael mine and other properties. Speaking at the XXVI Peruvian Mining Engineers Convention in Arequipa, the company's chief executive, Fausto Zavaleta, said Minsur was also studying the possibility of boosting output. The San Rafael underground mine, located in the southern highland region of Puno, is currently operating at 100% of its 2,500 t/d installed capacity.

Minsur is studying the possibility of a US\$20 million upgrade to expand capacity at the Funsur refinery. The company is also investing in a new tailings pad. The San Rafael mine has reserves of 15 Mt averaging 5% Sn. The mine has an estimated remaining life of 15 years. Minsur's claimed production costs of just US\$1,200/t are among the lowest in the world.

### **Bolivia**

Huanuni lost five weeks' output as a result of the strike that ended on November 4, 2003. The industrial action had begun on September 30 when most of the 800 miners working at Huanuni joined in the countrywide protests that toppled former President Gonzalo Sanchez de Lozada. The mine, which is operated by state-owned Comibol, declared *force majeure* two weeks into the strike. A clash between the striking miners and the Bolivian army left two miners dead and six wounded.

Huanuni produces an average of 320 t/mth of tin in concentrate and has proven and probable reserves of 3.6 Mt averaging 2.55% Sn. Comibol has been running Huanuni since the collapse into bankruptcy in 2002 of RBG Resources, the firm that, under the Allied Deals name, had purchased the mine at its privatisation. RBG had also purchased the Vinto tin smelter. The firm's liquidators sold the smelter to a joint venture between Comsur, which operates the Colquiri tin mine, and UK-based CDC Capital Partners.

Elsewhere, in the first quarter of 2004, US firm Coeur d'Alene Mines was working on a feasibility study for its San Bartolome gold-silver-tin mine project near Potosi.

### **Australia**

In May 2003, there was a fatality at the Renison Bell tin mine near Zeehan in Tasmania. A man died after a rock fall approximately 1,000 m underground.

Two years earlier, in 2001, two miners had died in similar circumstances. One month later, following temporary closure as a result of the death, the mine, with 220 employees, moved into voluntary administration with debts of A\$42 million, including more than A\$4 million owing to the state government. In September 2003, the Tasmanian Government offered a A\$600,000 loan to keep the mine in a viable operating state for a further two months while the administrator sought a buyer. However, by December 2, unable to find a buyer, the mine's administrator announced the water pumps would be stopped and the mine allowed to flood. In the first three months of 2003, the Renison Bell mine had produced 1,412 t of tin in concentrate.

Following the failure to find a buyer for the mine in 2003, the turn-around in the tin price itself in the first quarter of 2004 reignited interest and a plan to recommence mining was being put in place in April 2004 by the new owner, Bluestone Nominees.

In April 2003, Malaysia Smelting Corp raised its stake in Marlborough Resources, operator of the Ardlethan tin mine, to 30%. Six months later, in September, Marlborough said that production would rise by around 70% to some 2,200 t/y of tin in concentrate through the completion of a second treatment plant. Commissioning of the new plant began late in December.

The only other significant tin producer in Australia is Sons of Gwalia's Greenbushes tantalum mine which produces approximately 300 t/y of tin in concentrate as a by-product.

Malachite Resources announced plans in November 2003 to revive the Elsmore tin-sluicing mine, originally established near Inverell in 1971. The mine is approximately 25 km from Malachite's silver project in New South Wales.

## **Brazil**

In February 2003, a spokesman for Paranapanema admitted that reserves at its Pitinga mine were exhausted and that the firm was just reprocessing tailings. This, he said, would allow the firm to continue output at 2002's level of 8,900 t for another three years. However, by March 2004 it was being estimated that output could only be maintained at this level for one further year. Output from the once massive Bom Futuro 'garimpo' in Rondonia has also dried up.

Whether Brazil becomes a net importer of tin now appears to hang on the development of the Rochas Sa tin project. By the end of the first quarter of 2004 Paranapanema appeared to have secured a US\$20 million credit line from the federal development bank BNDES to carry out more work at Rocha Sa. Meantime, its Mamore smelting subsidiary shut down an unprofitable cassiterite beneficiation plant in Minas Gerais. For 2003 as a whole, Brazil produced a total of 10,700 t of tin of which some 6,300 t were consumed within Brazil.

### **Thailand**

Tongkah Harbour's tin ore sales totalled Bht20.83 million (US\$532,960) for the full year 2003, down 51% from Bht42.13 million in 2002. Tongkah uses contractors, operating their own dredges, to conduct offshore mining operations. However, the number of dredges in operation dropped from three in 2002 to one in 2003. In addition, mining operations were conducted for only eight months, from May to December, compared with 10 months in 2002. Despite higher tin prices, Tongkah's gross margin from tin remained at around 8% in 2003, much the same as 2002, as the company had to absorb an increased royalty fee as prices increased.

Thailand's tin metal production from the Thaisarco smelter fell by about 13% to 15,400 t for 2003, down from 17,800 t in the previous year, and against an installed capacity of 36,000 t/y. Primary tin output is under pressure and likely to fall again in 2004 as a result of concentrate shortages as feed from Peru and Indonesia is smelted domestically.

### **South Africa**

By January 2004, Phamine Mining was facing liquidation proceedings. The firm had hoped to supply around 75% of the country's 200 t/y tin demand but through 2003 it was unable to secure necessary financing and this delayed its planned listing on the Johannesburg stock exchange. Phamtin, part of Phamine, had begun preparations for a new tin smelting and concentrating operation in the country's northern Limpopo Province in 2002, using mine tailings as raw material.

### **Nigeria**

In August 2003, the Federal Government of Nigeria was accused of failing to assist its domestic mining industry. The accusation was made during the official visit of the Minister for Solid Mineral Development, Elder Odion Ugbesia, to the Makeri Smelting Co (MSC) in Jos. Speaking on behalf of the company, the executive vice chairman and chief executive, Mr M H Ochepe, called on the government to strengthen the existing alliance between African Tin Co (ATC) and Nigeria Mining Co (NMC) for the development of exploration and mining in the country.

The company requested further that, "through the ongoing restructure exercise, this alliance should be strengthened by the Nigeria Mining Co (NMC) opening up their good leases for tin, lead, zinc and columbite in order for ATC to take advantage of their foreign consultants already here with us". It also called on the government to put a stop to illegal mining.

### **CIS**

The Novosibirsk Tin Combine (NOK) produced around 4,100 t of tin in 2003 and expects to produce some 4,700 t in 2004. The long-term aim is to double output to just over 8,000 t/y. In order to provide the boost to concentrate input, NOK will increase investments in the Dalolovo, Vostokolovo, Khinganolovo and Deputatskolovo tin mines, from US\$5 million in 2003 to up to US\$8 million in 2004.

Vostokolovo and Dalolovo plan to increase deliveries of raw material to the Russian tin monopoly by 90% to 1,500 t. Deliveries of tin in concentrate from these units, which were set up with assets of the Solnechny GOK mining and milling combine in Khabarovsk territory, are expected to increase further to about 2,000 t in 2005.

Mine production will increase by stepping up operations at the existing Molodyozhnoye and Perevalnoye deposits, as well as by bringing production at the Pravouimiiskoye deposit up to commercial levels. The Pravouimiiskoye deposit has so far seen only seasonal mining by small mining crews. Preparations are now underway for larger-scale operations. There are also plans to modernise the beneficiation mill used by Vostokolovo and Dalolovo to increase capacity

Elsewhere, Tianshanolovo, the company that holds the licence to develop the Tsentralnoye section of the Trudovoye tin deposit (former Sary-Dzhaz mining and milling complex), has shut down operations. Tianshanolovo produced about 100 t of tin concentrate in 2002, 60% more than in the previous year but far below the target of 250 t.

In January 2004, Russian Prime Minister Mikhail Kasyanov signed a decree that imposed an import duty on tin and tin products amounting to 5% of the customs value, but not less than €0.2/kg.

### Malaysia

Malaysia Smelting Corp completed its acquisition of a 25% equity stake in Malaysia's ZR Network in the third quarter of 2003. In March 2003, ZR Network had entered into an agreement to purchase Rahman Hydraulic Tin's mining rights and related assets. Rahman operates an open-pit tin mine at Kelian Intan in North Perak, near the border with Thailand. The company's mining operation has been profitable over the past five years despite low tin prices and has been contributing positive cash flows. Over that period the mine has produced about 1,000 t/y of tin-in-concentrate.

MSC's total tin metal production reached 36,000 t for the year. The higher than expected output was due to additional scrap metal received and a steady supply of tin concentrate. The Butterworth plant, which has a design capacity of 30,000 t/y, produced about 18,000 t for 2003, 20% higher than the target of 15,000 t, and its 2002 purchase, 75%-owned Indonesian miner PT Koba Tin, produced around 18,000 t.

The company remains keen to acquire more mining assets and expects its tin metal output to be between 35,000 t and 40,000 t for 2004. PT MSC, a joint venture with Indonesian company, PT Mitra Stania Prima, should allow MSC to explore and subsequently mine tin in designated areas of Bangka Island, Indonesia under a production-sharing arrangement. MSC also increased its equity stake in Australian miner Marlborough Resources from 13% to 30%

Notwithstanding MSC's successful year, Malaysia's domestic mined tin output fell to around 3,700 t in 2003, down from 4,215 t in 2002, putting the country



in the bottom ranks of global tin producers. The fall in production came despite the rising tin price and could be mirrored by further falls unless the government opens more land and extends expired leases for mining.

### **Portugal**

After much prevarication, Rio Tinto and Empresa de Desenvolvimento Mineiro sold their respective 49% and 51% interests in Portugal's polymetallic Neves Corvo mine to Canadian mining company firm Eurozinc in the first quarter of 2004. The Canadian company, which operates the Aljustrel zinc mine in Portugal paid €128 million for the two groups' interests in Neves Corvo's operating company Somincor. Annual tin output at Neves Corvo has fluctuated between 350 t and 3,500 t since the mine started operating in 1989. However, Eurozinc says the tin resource is nearing exhaustion and forms little or no part in any future mining plans.

### **Czech Republic**

The Jeronym medieval tin mine in Krasno could be partly open to the public within two years. Industry and Trade Minister Milan Urban, and Environment Minister Libor Ambrozek, visited the mine in March 2003 and promised financial aid of Ko18 million to what the government believes is a unique national cultural monument. As a result of a cave-in, the mine has preserved its original appearance from the turn of the 15th and 16th centuries. The mine owner, the Diamo Pribram state enterprise, together with the Agricola Foundation, have been striving for a couple of years to make the mine accessible to visitors. The Jeronym mine was most active from the mid 15th century to the beginning of the 17th century. The total mining yield has been assessed at 500 - 700 t of tin.

### **UK**

By November 2003, there was again talk that the flooded South Crofty mine in Cornwall would be re-opened. Mine owner Baseresult Holdings began taking visitors into the mine in October but the firm's managing director claimed the company was still working on a way to restart mining operations, looking to produce around 200,000 t/y of 1% tin ore. By April 2004, following the tin price's rocket ride upwards, underground blasting to link two sections of the mine together was underway. Baseresult says it will begin pumping water out of the mine late in 2004 and expects to be producing tin concentrate in 2006. The mine currently contains around 5 Mm<sup>3</sup> of water and would take four years to completely dry out, although mining could begin before the process is complete.

### **US**

A total of 12,000 t of stockpiled tin was authorised for sale by the Defense Logistics Agency in fiscal 2003. However, sales during the year to end-September 2003, reached a total of 9,031 t, including 8,136 t sold via long-term negotiated contracts and 895 t sold through basic ordering agreement tenders throughout the 12-month period. The 'authorise for sale' figure remained unchanged for fiscal 2004. The DLA posts tin sales under the Basic Ordering Agreement on its website <https://www.dnsc.dla.mil>. As of September 30, 2003, the DLA held 35,663 t of tin, all of which is authorised for disposal.

## **Consumption**

Soldering and electrical applications account for around 31% of tin consumption. Tinsplate, the traditional end-use, is now some 29% and tin chemicals, organic and inorganic, account for 16%. Demand is buoyant, notably with lead-free applications growing in importance – tin being a substitute in both solder and shot.

Global tinsplate production has remained steady over the past few years at 14-15 Mt/y. Reduced output in developed economies has been comfortably offset by growth elsewhere. In the US, for example, the nation's number two tinsplate maker Weirton Steel shipped 863,000 t of tinsplate in 2003, making sales worth US\$510.3 million. But it was not enough: after a long battle to maintain 95% US tariffs against Japanese tin mill imports through to April 2005 and 11 months in Chapter 11 bankruptcy protection, Weirton was sold by a federal bankruptcy judge in April 2004. Apparently, the company has lost an average of US\$100 million per year since being purchased by its employees in 1984, despite a 25% share of the US tinsplate market.

In Canada, Dofasco announced a US\$700 million upgrade programme to include its tinsplating and rolling finishing operations. The firm has an annual combined tinsplate/tin-free steel capacity of 450,000 t.

Arcelor Packaging International announced plans in April to reduce its tinsplate production sites to no more than three by 2010. The firm, a subsidiary of Luxembourg-based Arcelor currently operates ten electrolytic tinning lines at six sites across France, Belgium and Spain. API holds a 40% share of the European tinsplate market, producing around 1.85 Mt/y from rated capacity of 2.1 Mt/y. Rasselstein Hoesch (Germany) and Corus (UK/Netherlands) each have a 20% share of the market, and the remaining 10% is supplied by Italian firm Riva Acciaio Spa.

Australian steel and tinsplate producer BHP Steel changed its name to Bluescope Steel, the change coming about as a condition of its separation from BHP Billiton.

Tinsplate, far from being a sunset industry, was blossoming in 2003. The US Steel Kosice venture has forecast tinsplate consumption in the Balkans and central Europe at 650,000 t/y by 2007, up from 370,000 t/y in 2002. Demand in neighbouring Turkey is expected to rise by 25% to 250,000 t for 2004, according to the country's only tinsplate producer, Erdemir.

In South America, Brazilian steel group Companhia Siderurgica Nacional invested in a new plant for its drinks can subsidiary Companhia Metalic do Nordeste; and in Asia, Malaysian tinsplate group Perstima developed its second tinsplate line, building a new production facility near Ho Chi Minh City in Vietnam.

The importance of tinsplate in the fast-developing Asian packaging markets was reinforced by the holding of the first Tin Technology Tinsplate Group



Seminar in Shanghai. However, we should not be left with the impression that tinplate does not continue to play an important role in the US and Europe. Around 4 Mt of tinplate is consumed in the US every year, and several investment programmes were underway in Europe through 2003.

A new 300,000 t/y tinning line came on stream at Arcelor's Aviles facility in Spain in October 2003. In Germany, Rasselstein Hoesch placed an order with Austrian firm Voest-Alpine and Belgian group Drever International to build a new 360,000 t/y annealing plant at Andernach. The new line is due to be operational by December 2005 at a cost of some €100 million.

Oddly enough, the commitment by Rasselstein Hoesch (a subsidiary of ThyssenKrupp) was made in the face of a slump in the consumption of tinplate for drinks cans in Germany, hit by the new Dosenpfand recycling regulations. This mandatory deposit scheme appears to have caused a slump of around 50% in beverage can demand in 2003.

Tinplate packaging continues to be used for gimmicks. The 'must-have' fashion accessory of summer 2003 in Japan was 'spray-on' tights. Tins of Air Stocking flew off the shelves in Japan, where most companies require women to cover their legs - even when it's hot. The product, a waterproof silk powder, comes in three shades.

Even food manufacturer Heinz created a stir, celebrating its 75th anniversary of its canned spaghetti in the UK by changing its '57 varieties' slogan to '75 varieties' on just 75 cans. In total in 2003, Heinz sold 103 million cans of spaghetti and spaghetti hoops.

In other areas of tin consumption, one unlooked-for consequence of the drive to remove lead from solder has been the return of the threat of 'tin whiskers'. These single-crystal, electrically conductive hair-like structures grow from pure tin surfaces. Tin whiskers have been blamed for blown fuses and relays that have caused the failure of three commercial satellites.

In September 2003, Osaka-based solder manufacturer Nihon Superior claimed it would gain a 10% share of the total global lead-free solder market by 2006, selling 10,000 t/y of solder, which contains 99.3% Sn, 0.7% Cu and extremely small quantities of nickel.

New Jersey firm Graphite Metallizing Corp launched a new tin Babbitt, which is environmentally friendly and may be used in potable water and food applications. The alloy is corrosion resistant in most liquids including many acids. It does not gall when run with close tolerances against rotating metal elements. Tin Babbitt is used in a full range of pumping applications.

Brush Wellman of Ohio unveiled a new copper-nickel-tin alloy dubbed ToughMet for use in bearings for applications such as mining equipment, aircraft and high performance automobiles. The alloy contains 8% Sn and has a fine homogenous microstructure.

In tin chemicals, Degussa of Germany's Degussa Advanced Nanomaterials unit announced plans to commercialise three nanoscale powders including an indium tin oxide. Used in surface coatings, the powder (AdNano ITO) prevents the sudden electrical (static) discharges that can damage electronic components in devices such as computers. It also reduces dust adhesion, a particularly desirable property in areas that need to be hygienic.

Due to its small particle size, AdNano ITO can be formulated for both transparent coatings (such as those used on acrylic windows) and for coloured coatings. Another advantage of the nanoscale indium tin oxide, Degussa states, is its infrared absorbency, which can reduce the energy charge in buildings or vehicles caused by solar-generated infrared radiation. This, in turn, reduces the energy requirements of air-conditioning equipment because the environments are already cooler.

Much of the effort round the world to further the development of new uses for tin continues to be fostered by ITRI Ltd. PT Timah announced its intention in May 2003 to rejoin ITRI Ltd (formerly the International Tin Research Institute) after withdrawing its membership two years ago. In September 2003 ITRI's sister organisation Tin Technology acquired the World Bureau of Metal Statistics.

Tables following pages.

<b>Tin-in-concentrate output ('000 t)</b>						
	<b>1998</b>	<b>1999</b>	<b>2000</b>	<b>2001</b>	<b>2002</b>	<b>2003</b>
Indonesia*	53.9	47.8	51.6	51.0	52.0	64.0
Peru	25.7	29.7	37.4	38.2	38.8	40.2
Bolivia	11.0	12.0	11.6	12.5	15.2	13.2
Brazil	14.2	13.2	14.2	13.8	12.0	10.4
Russia	4.5	4.5	5.0	4.5	4.5	4.1
Malaysia	5.7	7.3	6.3	5.1	4.2	3.7
Australia	10.2	11.0	9.5	8.9	7.5	2.8
Vietnam	4.5	4.0	4.1	4.5	4.7	2.5
Thailand	2.0	3.4	2.4	2.4	1.7	1.0
Portugal	2.9	2.2	2.3	1.2	0.3	0.2

\*PT Timah & PT Koba only, this figure does not take account of smuggled concentrates

<b>Average tin prices (US\$/lb)</b>	
1995	2.82
1996	2.80
1997	2.56
1998	2.51
1999	2.45
2000	2.46
2001	2.03
2002	1.84
2003	2.07
2004(f)	3.85

<b>Chinese tin metal production and exports (2003)</b>		
	<b>Production (t)</b>	<b>Exports (t)*</b>
January	6,282	4,139
February	5,817	3,559
March	7,485	3,472
April	7,730	3,238
May	7,400	3,558
June	7,887	3,841
July	7,179	3,807
August	8,928	2,750
September	7,331	3,815
October	7,827	2,827
November	8,270	2,902
December	17,198	3,312
<b>Total</b>	<b>100,047</b>	<b>41,220</b>

\*unwrought tin and tin alloys. (Export stats - China Economic Information Service  
Production stats - China Materials Information Centre)

NB There is a discrepancy between the total of the monthly stats and the reported annual figure.